Laboratory on the Internet

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Background. Current computer technology has provided a means for modeling the nonlinear dynamics of complex physiological systems. These computer models can then be used in simulation studies to theoretically examine the integrated interactions and functioning of human physiology.[1] When used in this way, the models and simulations serve as a platform for the development of very sophisticated hypotheses. Such simulated experiments have also been shown to be effective teaching tools for medical students when compared to traditional animal laboratories.[2] An Internet simulation laboratory has been developed as a part of the website of the Department of Physiology at the University of Mississippi Medical Center *(http://phys-main.umsmed.edu)*. The lab includes tools and instructions for the development of computer models in physiology as well as a number of completed models that can be used in research or student labs.

System. The website contains two main areas for those interested in computer modeling.

The *Modeling Workshop* is comprised of:
1. A section dedicated to those interested in learning how to develop computer models. This includes information on mathematical and physiological concepts as well as an available simulation software (DESolver) developed by Coleman.
2. A section of completed models along with their documentation can be downloaded to run in the DESolver or VisSim (Visual Solutions, Inc.) simulation platforms. These models may be used for student laboratories or for demonstrating simple physiologic concepts.
3. A section in which the components and equations of previously developed models can be explored and modified using DESolver.

QCP2 The site also includes access to a copy of a comprehensive model of human physiology (QCP2). QCP2 is an elegant computer program developed by Coleman that simulates the dynamic interactions of integrative physiology and can be run on most IBM compatibles. This model is the successor to the popular HUMAN program already in use in many medical schools. Elements of respiratory, circulatory, endocrine, neural, and renal physiology have been combined to characterize both the fundamentals and details of human physiology. The user can see the effects of changes in specific parameters such as heart rate or peripheral resistance on the physiology of the body as a whole. There is also a case-oriented approach that simulates a specific physiologic, pathologic or environmental condition (i.e. exercise, high altitude, shock, etc.) with the resultant typical systems perturbations and responses. While primarily designed as a teaching tool, this program also provides insight into important physiologic questions from the integrated, systems analysis perspective. The complete QCP2 program can be downloaded as a zip file from the website and used as freeware.

Evaluation. The models in the workshop have been used with success as a part of the physiology laboratory course within our medical school. The students find the models useful in exploring concepts that are difficult to demonstrate in traditional wet labs. The ease of use of QCP2 has made this program particularly popular among the students. The modeling workshop is also a part of the graduate student curriculum in the physiology department. In using this technology the students are introduced to the methodology of developing complex hypotheses.

Conclusion. Computer models and simulations provide a theory-based, electronic laboratory that can be used for both scientific and educational purposes. Making this technology available on the Internet allows for the free exchange of ideas and enriches the general academic medical community.

References

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